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ABSTRACT

A study developed a multiple regression prediction equation for each of six selected achievement variables in a popular standardized test of achievement. Subjects, 42 fourth-grade pupils randomly selected across several classes in a large elementary school in a north Florida city, were administered several standardized tests to determine predictor variables of vocabulary, general information (prior learning), arithmetic, word recognition, and listening skills. The dependent variables (reading vocabulary, reading comprehension, language total, math total, science, and social studies) were measured using subtests or combinations of subtests of the California Achievement Test, Form E. Data were processed by computer programs and yielded mean scores, a correlation matrix, multiple correlations, and regression prediction formulas for each dependent variable. The multiple correlations obtained ranged from a low of .77 for reading vocabulary to a high of .87 for mathematics total. Each regression equation also had its own constant. Suggestions are offered for improving students' word recognition skills, listening skills, and the quantity and quality of their stores of vocabulary and general information. (Three tables of data are included; 23 references are attached.) (RS)

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DEVELOPMENT OF MULTIPLE REGRESSION EQUATIONS TO PREDICT FOURTH GRADERS' ACHIEVEMENT IN READING AND SELECTED CONTENT AREAS

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DEVELOPMENT OF MULTIPLE REGRESSION EQUATIONS TO PREDICT FOURTH GRADERS' ACHIEVEMENT IN READING AND SELECTED CONTENT AREAS

When is a person well educated? The answer to that question varies greatly according to people's backgrounds, their own education, and their answers to such existential questions as, "Who am I? Where did I come from? What am I doing here? and Where am I going?" Albert Speer, the architect and Nazi who was Hitler's master logistics expert in the fields of armaments, munitions, and slave control, lamented his receiving only a technical education, learning little of the humanities and the liberal arts and nothing whatsoever of philosophy. He stated that he and others were technical barbarians who never probed the reasons for and the end results of things they did for Hitler. (Interview by Phil Donahue, ca. 1966; excerpts reported in Hafner, 1977, p. 189). In the great scheme of things, a "liberal education that educates cognitively and affectively is a very practical education" (Hafner, 1977, p. 189).

Whether people are attaining a technical education plus some liberal studies or a solid liberal education, they must be able to read well. The ability to read with

good comprehension is rooted first of all in a well developed vocabulary (Hall & Tirre, 1979. "Not only are words the medium of daily interaction with our fellows, they are the chief vehicle of learning in school and out (Hafner & Jolly, 1982, pp. 139-140). The reader must also come to the printed page with an adequate store of prior knowledge (Devine, 1986).* Vocabulary and prior knowledge have been characterized as mental powder. Lack of adequate mental powder = poor "mental explosions" (understanding).

However, Scott and Hafner (1987) note that:

> As reading specialists, we have spent many hours observing children in regular classrooms and reading clinics. In recent years we have noted significant changes in the way children are performing in classrooms as well as in clinic situations. Too many of our school age children fail to acquire the knowledge base

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* Prior knowledge, along with other factors such as "linguistic competence, memory, and schemata..., plays a crucial role in the way readers comprehend printed materials and organize important ideas so they can be retrieved at another time" [Cagney, M. A., in Glazer, et al., 1988].

> which is needed to cope with today's academic demands. It is a good knowledge base that permits children to understand what they read. (p. 16).

The ability to read well and to score on standardized achievement tests also requires one to decode the printed word. Two studies, each of a different type, show the importance of word recognition to reading comprehension. Stanovich, et al (1986) found that pseudoword naming time correlated -.76 with comprehension scores on the Metropolitan Achievement Test. That is, the less time it took to read the pseudowords, the higher the comprehension score. Tindal and Marston (1986) reported correlations in the 0.80 between reading aloud from word lists and norm-referenced test performance.

Further information on the importance of decoding ability can be seen in a study by Horowitz and Samuels (1985). They noted that poor readers with a general language deficit should show reduced scores in listening comprehension as well as in reading comprehension. Good and poor readers in middle-class schools in Minneapolis suburbs read aloud and listened to both hard and easy expository texts. Their recalls were scored for number of idea units produced. There was no significant difference between good and poor readers in either the hard or easy

texts. Evidently poor readers did not have a general language problem. This suggested a deficiency in decoding ability.

What other factors are related to the ability to decode text and comprehend the messages? Listening comprehension, or auding, is construed as the ability to listen to spoken text and understand the speaker's message; this understanding can be shown by answering questions about the message. The correlation between listening comprehension and reading comprehension increases from 0.35 in first grade to approximately 0.60 in the fourth grade and remains rather constant thereafter (Sticht & James, 1984). Noteworthy is the fact that after students become mature readers, whatever training benefits listening comprehension also benefits reading comprehension and vice versa, according to Pearson & Fielding (1982).

One can see how vocabulary, general information, word recognition, and listening ability undergird reading comprehension in general, but some of these abilities also affect achievement in content areas such as mathematics, language arts, science, and social studies. Sattler (1982, p. 174) points out that numerical reasoning is necessary for solving arithmetic problems. Arithmetic achievement also requires (1) concentration to a greater extent that either a vocabulary or an information aptitude test and (2) the active application of select skills to

cope with new and unique situations (Blatt & Allison, 1968). Language arts achievement can be construed in a number of ways. Various aspects are emphasized more at certain grade levels and less at others. Language mechanics in the middle grades, for example, might include skills in the mechanics of capitalization and punctuation. Language expression could include skills in language usage and structure. In considering what might contribute to science and social studies achievement, one might hypothesize that all of the following abilities would: word recognition, arithmetic, general information, vocabulary, and listening comprehension. That would be correct. It is also true of the other achievement variables previously discussed. But only certain ones, as will be seen, contribute to a multiple regression prediction equation of these achievement variables.

Purpose of the Study

The purpose of conducting this study was to see which abilities are important to students' doing well on a popular standardized test of achievement. The specific purpose was to develop a multiple regression prediction equation for each of six selected achievement variables in the test. Another purpose was to utilize the findings to show the need to help teachers improve the strength of their pupils'

predictor variables. The final purpose was to provide some suggestions for improving word recognition skills, listening skills, and the quantity and quality of their stores of vocabulary and general information, thereby increasing achievement.

Although most of the predictor variables would likely show a correlation coefficient of at least 0.50, a way of selecting which sets of variables "worked together" to give the best means of predicting achievement on the selected tests was needed.

Method

Participants

The participants in the study were 42 fourth grade pupils randomly selected across several classes in a large elementary school in a north Florida city.

Data Collection

The predictor variables and the instruments used were: vocabulary, general information, and arithmetic--measured by tests from the Wechsler Intelligence Scale for Children - Revised (WISC-R) (D. Wechsler, 1974); word recognition, San Diego Quick Assessment List (SDQAL), (LaPray & Ross, 1969); and the ECHO Reading Procedure--a listening test (Gillet & Temple, 1986, pp. 82, 83). All of the predictor tests were administered individually by the researcher.

The following dependent variables are all subtests or combinations of subtests of the California Achievement Tests, Form E, Level 14, which was administered by testing specialists of the elementary school the subjects attended: Reading Vocabulary, Reading Comprehension; Language Total--comprised of Language Mechanics and Language Expression; Math Total--comprised of Mathematics Computation and Mathematics Concepts and Applications; Science; and Social Studies.

Predictor variable scores were either in grade level equivalents or translated to grade level equivalents. Dependent variable scores were already translated to grade level equivalents. Prediction data were obtained in the seventh month of the school year, 4.7. Achievement data were obtained in the eighth month, 4.8.

Data Analysis

Data were processed by computer programs that yielded (1) the mean scores and standard deviations for each variable; (2) a correlation matrix of the predictor variable scores versus the dependent variable scores; (3) the multiple correlations; and (4) the regression prediction formulas for each dependent variable.

Results

Table 1 shows the mean and standard deviation for each variable. The general information mean was relatively weak; word recognition and listening were slightly above 4.7; and arithmetic and vocabulary were "strong." For the dependent variables, reading comprehension, math total, and social studies were slightly below the 4.7 figure. Reading vocabulary and language total were "strong."

Table 1

Means and Standard Deviations

for the Predictor Variables and the Dependent Variables

Predictor Vs	Mean	SD	Dependent Vs	Mean	SD
Word Recognition	4.85	1.77	Reading Vocab.	5.45	3.01
Arithmetic	5.32	2.59	Reading Comp.	4.57	2.58
General Info.	4.37	1.42	Language Total	5.48	3.19
Vocabulary	5.61	2.09	Math Total	4.58	1.87
Listening	4.85	0.77	Science	3.89	2.78
			Social Studies	4.59	2.205

Table 2 shows the correlation matrix and the multiple Rs for the predictor variables versus the achievement variables. The correlations range from an unexpected low of 0.43 between general information and reading comprehension to a high of 0.76 between vocabulary and science. The multiple Rs range from a low of 0.77 for reading vocabulary to 0.87 for mathematics total.

Table 2

Correlation Matrix for Five Predictor Variables and Six CAT-E Achievement Variables for a Sample of Fourth Graders

Predictor Variables	Achievement Variables					
	Rdg. Voc.	Rdg. Comp.	Lang. Total	Math Total	Science	Soc. Stud.
W. Recognition	.66	.70	.69	.65	.64	.635
Arith [WISC-R]	.52	.50	.64	.75	.59	.57
Gen Info [WISC-R]	.58	.43	.58	.67	.585	.45
Vocab [WISC-R]	.67	.64	.66	.73	.76	.73
Listening [ECHO]	.52	.65	.66	.60	.58	.55
Multiple R	(.77)	(.785)	(.79)	(.87)	(.82)	(.80)

Table 3 shows that each achievement variable except Math Total had two predictor variables in its regression equation. Math Total, with the highest Multiple R, 0.87, required four predictors. The multiple regression prediction equations in Table 3 show (1) WISC-R vocabulary to be involved in four of the equations--Reading Vocabulary,

Language Total, Science, and Social Studies; (2) Word Recognition in (all) six equations; (3) Vocabulary and Word Recognition jointly in four equations--Reading Vocabulary, Language Total, Science, and Social Studies; (4) Listening in two equations--Reading Comprehension and Math Total; and (5) General Information in one--Math Total.

Table 3

The Multiple Regression Predictions Equations for the Selected CAT-E (Level 14) Achievement Variables

Achievement Dependent Variable		Predictor Variables, Including the Constant
Reading vocabulary	=	Vocab (.66) + W. Recog (.74) + (-1.80)
Standard error (SE)	=	.17 .20 1.01
Reading comprehension	=	W. Recog (.73) + Listening (1.37) -5.57
	SE =	.17 .38 1.64
Language Total	=	W. Recog (.87) + Vocab (.65) -2.39
	SE =	.20 .17 1.04
Math total	=	Arith (.25) + Gen. Info. (.46) + W. Recog (.23) +
	SE =	.08 .125 .11
		Listening (.48) -2.22
	SE =	.24 1.00
Science	=	Vocabulary (.77) + W. Recog (.57) -3.20
	SE =	.14 .16 .83
Social Studies	=	Vocabulary (.57) + W. Recog. (.46) -.87
	SE =	.12 .14 .70

Discussion

Inspection of Table 3 reveals the loading of word recognition on all of these CAT-E tests. This finding seems quite reasonable because they all require the examinee to read, which involves word recognition. The involvement of vocabulary, but not general information, is quite understandable for Reading Vocabulary. And the lack of general information in the prediction equation for Language Total can be explained by the fact that general information concepts play no part in the Language Mechanics sub-section of this test (CAT-E, Level 14), and appear in only eight--and that minimally--of the 55 items in the Language Expression subtest.

Since, of all the WISC-R subtests, Vocabulary correlates the highest with total intelligence, which has a reasoning factor, one can assume the ability to reason--a requirement for solving most of the 40 items on the Science test (CAT-E)--to be related to the reasoning ability needed to see relationships among science concepts.

Memory--and almost by definition, concentration--and verbal ability are involved in the Listening test (ECHO-Reading). Therefore, the Listening test's strong role in the CAT-E Reading Comprehension test and the Mathematics test, both of which require the ability to keep ideas in mind, determine the relationships among them in order to fully understand text problems and determine test answers, is quite logical and understandable. In like manner, the Arithmetic predictor variable requires the ability to (1) concentrate; (2) to remember the components of the problem, most of which are presented orally by the examiner; and (3) to employ numerical reasoning. All these are entailed in solving the various tasks in the Mathematics Computation Problems and the tasks in the Mathematics Concepts and Applications sections that comprise Math Total.

Recommendations

Suggestions for Improving Word Recognition, Vocabulary, Listening, and General Information/Prior Knowledge

Word Recognition. Children who are read to from infancy on, are surrounded by books, see their parents read, get to explore more than their backyard, and play

games that help develop auditory segmentation and auditory blending skills are at an advantage in learning to recognize printed words. Children are served well through whole language approaches to reading through writing. Various whole language strategies designed to benefit children's progress in word recognition, language growth, and the like appear in Literacy's Beginnings by McGee and Richgels (1990), especially in Chapter 5, titled "Threes, Fours, and Fives Becoming Novice Readers and Writers," and Chapter 6, "Classroom Support for Novice Readers and Writers."

Skill approaches can supplement and reinforce whole language approaches. In their chapter titled "Strategies for Teaching Initial Reading Acquisition," Hafner and Jolly (1982) explicate such strategies for teaching word identification as (1) association of printed word with a picture, (2) knowing what a word is and isn't, and (3) illustrated phrases for teaching function words. Titles of strategies in their chapter involving art that might come close to being whole language include among others (1) Round things, (2) Illustrated nursery rhymes, (3) Seasonal charts, (4) Photograph illustrated, and (5) Cartoon illustrated. Commercial software programs designed for use in home and/or school computers can be useful in teaching word identification.

Vocabulary. Parents and teachers should go all out and develop or take advantage of the most suitable experiences needed for their children to develop vocabulary and prior information. The school must make available a wide variety of up-dated teaching materials, including pertinent trade books, maps, charts, filmstrips, television lessons, and computer software; and teachers need to use them creatively. A detailed, practical discussion on the importance of experiences and the types of real and vicarious experiences that teachers can help children get, plus a set of guiding principles to follow in planning a program to enhance vocabulary development can be found in Hafner and Jolly (1982, pp. 141 ff.). Because of the nature of the suggested activities, concomitant growth in general information can be expected.

Listening. Tierney, Readence, and Dishner (1990, pp. 321) note that "perhaps the most neglected language art in terms of the amount of instructional time allocated to it, is that of listening." Listening, they maintain, can help students in their comprehension and learning. They explain in detail the Structured Listening Activity developed by Choate and Rakes (1987). This activity can be used with primary level children and "is designed to improve their comprehension of basal stories. It can also be used to teach comprehension skills and to reinforce

vocabulary and concepts from other lessons." Tierney et al. delineate two other listening strategies--the Listening-Reading Transfer Lesson (Cunningham, 1975) and Castallo's (1976) Listening Guides, teacher-constructed outlines used to guide students' notetaking.

General Information. Specific steps can be taken to develop general information or prior knowledge. One such approach by Scott and Hafner (1987) is predicated on the lack of general information and of prior knowledge on a variety of topics exhibited by pupils they tested in clinic situations. They gave examples of the types of questions asked Carrie, a fourth grader, on several kinds of written and oral examinations appropriate for children between the ages of 5 and 9.

> ...It quickly became clear that Carrie could not respond adequately in any of the areas. Her facial expressions indicated surprise, confusion, and bewilderment. She seemed embarrassed by her inability to answer incorrectly. Nonverbal behavior signaled that she knew she was not performing well and that this was information she should know. (Scott & Hafner, 1987).

They noted, however, that Carrie was not an isolated case. This lack of specific skills and general knowledge

is exhibited by an increasing number of students. The research cited in their article and their observations gave them this message: "Children who don't have at their disposal the quantity and quality of general knowledge, general content vocabulary, and the connecting skills needed to retrieve the concepts in learning situations are not succeeding in reading and other academic areas."

What can be done to help the Carries in our schools? Stevens (1982) showed that by teaching topical knowledge students' reading comprehension can be improved. In order to help teachers integrate some important concepts into pupils' conceptual frameworks, Scott and Hafner proposed teaching concepts in these five categories of topical knowledge: (1) geography/history, (2) measurement and time, (3) labeling language, (4) government, and (5) health/physical science. Content like this, they point out, is found in some curriculum guidelines, but is is not always introduced and taught to children. Their article provides a number of discussion starters for increasing knowledge and a practical sample lesson on the topic, "Why We Have Deserts."

Summary

A good education should educate the mind and the emotions. Both the technical education and the liberal

education require the ability to read, and this ability to read with comprehension and be successful in content areas is thought to be undergirded by proficiency (in various combinations) in word recognition, listening (comprehension), and arithmetic reasoning plus a well-developed vocabulary and adequate stores of general information.

The main purpose of the study was to ascertain multiple correlations and develop multiple regression equations, utilizing the previously mentioned variables of word recognition, arithmetic reasoning, vocabulary, general information, and listening ability to predict standardized test scores in reading vocabulary, reading comprehension, language total, math total, science, and social studies.

The obtained multiple correlations ranged from a low of 0.77 for reading vocabulary to a high of 0.87 for mathematics total. Each achievement variable except Math Total had two predictor variables in its regression equation. Math Total required four predictors and can be considered the most complex achievement variable. Of particular interest are reading vocabulary's two predictor variables--word recognition and vocabulary--and reading comprehension's predictors--word recognition and listening. Each regression equation also had its own constant.

Since the predictor variables (skills, abilities) play such important rolls in achievement, means for improving

four of the predictors were discussed rather than means of teaching the reading skills and the content skills directly.

References

Blatt, S. J., & Allison, J. (1968). The intelligence test in personality assessment. In A. I. Rabin (Ed.), Projective Techniques in Personality Assessment. New York: Springer, 421-460.

Cagney, M. A. Measuring comprehension: Alternative diagnostic approaches. In Glazer, S. M., Searfoss, L. W., & Gentile, L. M. (Eds.). (1988). Reeexamining Reading Diagnosis. Newark, DE: International Reading Association.

California Achievement Tests, Form E, Level 14. Monterey, CA: CTB/McGraw-Hill, 1985.

Choate, J. S., & Rakes, T. A. (1987). The structured listening activity: A model for improving listening comprehension. Reading Teacher, 41(2), 194-200.

Castallo, R. (1976). Listening guide--A first step toward notetaking and listening skills. Journal of Reading, 19(4), 289-290.

Cunningham, P. M. (1975). Transferring comprehension from listening to reading. Reading Teacher, 29(2), 169-172.

Gillet, J. W., & Temple, C. (1986). Understanding Reading Problems: Assessment and Instruction. Second edition. Boston: Little, Brown.

Hafner, L. E. (1977). Developmental Reading in Middle and Secondary Schools. New York: Macmillan.

Hafner, L. E., & Jolly, H. B. (1982). Teaching Reading to Children. Second Edition. New York: Macmillan.

Hall, W. S., & Tirre, W. C. (May 1979). The communicative environment of young children: Social class, ethnic, and situational differences (Tech. Rep. No. 125). Urbana, IL: University of Illinois, Center for the Study of Reading. (ED 170 788).

Horowitz, R., & Samuels, S. J. (1985). Reading and listening to expository text. Journal of Reading Behavior, 17(3), 185-98.

LaPray, M., & Ross, R. (January 1969). The graded word list: Quick gauge of reading ability. Journal of Reading, 12(4), 305-307.

McGee, L. M., & Richgels, D. J. (1990). Literacy's Beginnings. Boston: Allyn & Bacon.

Pearson, P. D., & Fielding, L. (September 1982). Research update: Listening comprehension. Language Arts, 59, 617-629.

Sattler, J. M. (1982). Assessment of Children's Intelligence and Special Abilities. Second edition. Boston: Allyn & Bacon.

Scott, D., & Hafner, L. E. (December 1987). Topical knowledge: A key to reading success. Florida Reading Quarterly, 16-20.

Stanovich, K. E., Nathan, R. G., & Vala-Rossi, M. (Summer 1986). Developmental changes in the cognitive correlates of reading ability and the developmental lag hypothesis. Reading Research Quarterly, 21(3), 267-283.

Stevens, K. C. (1982). Can we improve reading by teaching background information? Journal of Reading, 25(4), 326-329.

Sticht, T. G., & James, J. H. (1984). Listening and reading. In P. D. Pearson (Ed.), Handbook of Reading Research. New York: Longman, 293-317.

Tierney, R. J. Readence, J. E., & Dishner, E. K. (1990). Reading Strategies and Practices. Third edition. Boston: Allyn and Bacon.

Tindall, G., & Marston, D. (1986). Approaches to assessment. In J. K. Torgesen & B.Y.L. Wong (Eds.), Psychological and educational perspectives on learning disabilities. New York: Academic Press, 55-84.

Wechsler, D. (1974). Wechsler Intelligence Scale for Children - Revised. New York: Psychological Corporation.